

The following table exhibits the range of discordance in apparent places of *Polaris* between the *N.A.* and *C.T.* for various years :—

Year.	Range in R.A.	Range in N.P.D.
	^s	["]
1875	0.00	0.0
1880	0.09	0.3
1883	0.19	0.3
1886	0.18	0.4
1887	0.18	0.3
1888	0.57	0.2
1891	0.46	0.2

Concerning the reason for this discrepancy M. Lœwy kindly informs me that from 1888 the formulæ of Fabritius have been used in obtaining apparent places for the *C.T.*, and this change would appear to be an advantage on comparing the *C.T.* and *N.A.* respectively with other ephemerides. The following table shows the range of the differences in the apparent R.A.'s of the four circumpolars for the year 1890 :—

	<i>B.J.-N.A.</i>	<i>B.J.-C.T.</i>
	^s	^s
<i>Polaris</i> ...	0.45	0.12
<i>Cephei</i> 51 ...	0.29	0.04
δ <i>Ursæ Minoris</i> ...	0.21	0.04
λ <i>Ursæ Minoris</i> ...	0.86	0.13

With regard to the N.P.D.s it may be questioned whether computation to one place of decimals is quite enough. It is apparently to this that we may trace the discordances ranging one or two tenths on either side of zero, which thus become sensible. The range corresponding to 0".3 in right ascension of *Polaris* would be $0^s.3 \div 15 \sin N.P.D. = 0^s.9$, about which some care is taken in computation. There appears to be no reason for withholding the same care from N.P.D. computations; and this remark would apply to all stars.

Photograph of Stars in the region of Tycho's Nova.

By Isaac Roberts.

The photograph which accompanies this communication was taken on January 12, 1890, with an exposure of the plate during 2 hours and 55 minutes. The right ascension at the middle of the plate is about 0^h 16^m, and the declination north 63° 18'. Four pencil lines, enclosing a rectangular space, are drawn on the photograph, so as to correspond with the chart of this region made by D'Arrest in 1864, and the position of the *Nova*, as given by him, is shown marked by a white circle.

D'Arrest has charted the stars to the 16th magnitude, and the photograph, when examined with a magnifier, shows them to probably the 17th magnitude.

There is no appearance of either a nebula or of a star on the photograph in or about the position indicated by D'Arrest, namely, R.A. $0^h 17^m 7^s$, Decl. $+63^\circ 23' 5''$, but if we compare D'Arrest's chart and catalogue of the stars with the photograph, it will be seen that changes have taken place both in the positions and magnitudes of several of the stars since 1864. The following particulars will illustrate some of these changes; but they are not to be considered as a complete discussion of D'Arrest's chart. The stellar numbers and coordinates of the positions are those given by D'Arrest.

The star No. 15, R.A. $0^h 15^m 13^s$, Decl. $63^\circ 9'$, is shown on the chart to be 13th magnitude, but on the photograph it is only about 17th magnitude.

The star No. 72, R.A. $0^h 16^m 20^s$, Decl. $63^\circ 13'$, magnitude 11-12, has changed in its position-angle to the extent of about 55° , from south following to south preceding the 11-12th magnitude star, No. 69, R.A. $0^h 16^m 17^s$, Decl. $63^\circ 14'$.

The double star No. 153, magnitude 14, R.A. $0^h 17^m 45^s$, Decl. $63^\circ 22'$, has changed its position-angle by moving towards the preceding side with reference to the star No. 159, magnitude 11-12, R.A. $0^h 17^m 51^s$, Decl. $63^\circ 23'$.

The 11th magnitude star, No. 83, R.A. $0^h 16^m 34^s$, Decl. $63^\circ 26'$, does not appear on the photograph.

The two stars, No. 100, R.A. $0^h 16^m 49^s$, Decl. $63^\circ 11' 6''$, and No. 97, R.A. $0^h 16^m 48^s$, Decl. $63^\circ 13' 5''$, have changed in magnitude from 11th to about the 16th.

The 12-13th magnitude star, No. 120, R.A. $0^h 17^m 12^s$, Decl. $63^\circ 50'$, has changed its position-angle by moving about 30° towards the south following direction.

The 11th magnitude star, No. 203, R.A. $0^h 18^m 52^s$, Decl. $63^\circ 27' 4''$, has changed in its position-angle about 35° towards the north following direction.

The 11th magnitude star, No. 37, R.A. $0^h 15^m 45^s$, Decl. $63^\circ 32'$, has changed its position-angle with reference to the star No. 36, magnitude 11, R.A. $0^h 15^m 44^s$, Decl. $63^\circ 34'$, from south following to south preceding.

The star No. 33, R.A. $0^h 15^m 40^s$, Decl. $63^\circ 36'$, magnitude 10-11, does not appear on the photograph.

The following group of four stars are not recognisable on the photograph, and no stars appear exactly where they are shown:—

Star No.	h	m	s	
3,	R.A. 0	14	53,	Dec. $63^\circ 37' 6''$, 10-11th Mag.
4,	"	0	14 53,	" $63^\circ 38' 7''$, 11th "
8,	"	0	15 3,	" $63^\circ 37' 6''$, 11th "
12,	"	0	15 8,	" $63^\circ 38' 2''$, 10th "

The changes which have now been particularised are important when we consider that they apply to less than half a degree in right ascension, and one degree in declination; but there are two causes of uncertainty to be taken into account before we can give full acceptance to the objective reality of these changes.

1st. Photographic magnitudes of stars do not all agree with those which have been determined by eye observations, and this fact may account for some of the differences in the magnitudes.

2nd. There may be errors in the charting by eye observations, notwithstanding the greatest care and skill on the part of the observer, but any uncertainties that may appertain to them, as well as to the subject matters of this communication, can now be removed by those who possess the necessary optical power; for the exact nature of the changes to be determined has been pointed out by photography, and the essential data furnished for the purpose. That the stars, Nos. 3, 4, 8, 12, 33, and 83, which have been referred to as shown on D'Arrest's chart, and not shown on the photograph, are absent on the latter on account of some physical change having taken place in the stars, receives confirmation by the fact that the photograph shows more than 400 stars on a sky space where D'Arrest has charted only 212 stars.

I am indebted to Dr. Pechüle, of Copenhagen, for a copy of D'Arrest's chart and catalogue, and he informs me that he has for some years kept a watch upon the region of the *Nova*.

Note on the Sun-spots of 1889. By E. W. Maunder.

Though the Sun-spots of 1889 were few in number and generally small in area they presented some characteristics of especial interest; for the past year saw the close of one cycle of solar activity and the commencement of a new one, and the peculiar features of a transition period were well illustrated by the spot-groups which came under observation.

General Features of the Sun-spot Record of 1889.

From every point of view 1889 was a less fertile year than those which preceded it. Without going back to 1884 or 1885—years of great activity—it may be useful to compare it with 1886 and the two succeeding years, for in 1886 there was a lull of so pronounced a character in the late autumn as to lead one experienced solar observer to regard it as probably the true minimum. The following table shows how 1889 compares with the years preceding it as to days without spots, number of spot-groups observed, and mean daily spotted area:—